SHORTER ARTICLES AND DISCUSSION

VIABILITY AND COUPLING IN DROSOPHILA

In the course of work done in the college year, 1911–12, under the direction of Dr. Castle, at the Harvard Zoological Laboratory, Cambridge, Mass., an experiment was performed to test the relative viability of the red-eyed and the white-eyed stock of *Drosophila ampelophila* Loew. The white-eyed race was obtained from Professor Morgan, while the red-eyed material was reared from banana exposed near the laboratory.

A large glass jar well supplied with fermenting banana and tightly covered with a double layer of closely woven cheese-cloth was used for the experiment. Five pairs of flies from the red-eyed stock and five pairs from the white-eyed stock were introduced on November 29, 1911. After a few weeks the jar was well supplied with flies of both eye-colors, but the red-eyes considerably surpassed the whites in number. Fresh food was introduced once and on February 12 a number of the flies were drawn off and counted.

Let us consider here what the expectation of the ratio between reds and whites would be, after the culture had been running indefinitely. Assuming equal viability of the two races, we should expect equality of reds and whites among the males, and three reds to one white among the females. This appears from the following combinations based upon Morgan's formulæ. The mutation producing white eyes, being recessive to the wild type, has been denoted by a small letter as suggested by Castle.[1]

Red female gives gametes x and x.

White female gives gametes wx and wx.

Red male gives gametes x and —.

White male gives gametes wx and —.

The combinations will then be as follows:

$$\begin{array}{llll} 2wx\,— = 2 \text{ white males}, & 1\ x\ \ x & \left.\begin{array}{l}\\ \\ \end{array}\right\} = 3 \text{ red females}, \\ 2x\ \ — = 2 \text{ red males}, & 2\ wx\ \ x & \\ & 1\ wx\ \ wx & = 1 \text{ white female}. \end{array}$$

[1] "Simplification of Mendelian Formulæ," AMERICAN NATURALIST, XLVII, 555, March, 1913.

It is evident upon inspection of these formulæ that although the red females have gained over the whites, this is due solely to the formation of two heterozygotes where at first we had a pure red and a pure white. Since the ratio of the three types of gametes does not change, we may expect the above recorded ratios of red and white flies to persist indefinitely.

Let us now observe the results of counts and compare these with the theoretical ratio. The count of February 12 gave 129 red males, 202 red females, 21 white males and 3 white females. Instead of equality in the males, we have 6 reds to 1 white, and instead of 3 to 1 in the females, we have 67 reds to 1 white.

On March 13 flies were again drawn off from the jar and counted, giving 303 red males, 514 red females, 36 white males and 2 white females. The males are now 8.42 reds to 1 white and the females 257 reds to 1 white.

On April 12 a count showed 1,341 red males, 1,363 red females, 95 white males and 24 white females, or 14.1 reds to 1 white among the males, and 56.8 reds to 1 white among the females.

In general these results show that the reds are outrunning the whites. Disregarding sex we expect a ratio of 5 reds to 3 whites to persist in the population. On February 12 we get 14 to 1; on March 13, 21.5 to 1 and on April 12, 22.7 to 1. On April 12 there are more white females than would be expected, an irregularity which can apparently be explained only by chance. The great excess of females in the first two counts probably denotes that the lethal factor clearly demonstrated by Morgan[2] was present in the stock and the equality of the sexes in the last count denotes that the lethal factor has been bred out.

Among the flies examined in the last count were a few reds in which the eyes were reduced to about one fourth the normal diameter, and also a spotted-eyed fly which was not counted in the numbers recorded. The latter had the right eye red with a white patch four ommatidia in diameter near the vertex, and the left eye white with a red spot eight to twelve ommatidia in diameter with a few smaller red spots below it near the posterior margin. Later examinations of the culture were made in the hope of obtaining a spotted-eye fly alive, but these were without success.

[2] "The Explanation of a New Sex Ratio in *Drosophila*," *Science*, N. S., XXXVI, 934, November, 1912.

Small-eyed flies were obtained from the same stock and further work is now being done with these.

The association of the differential factor between colored and white eyes, *w*, with the differential factor between long and miniature wings, *m*, was tested. Matings were made between white-shorts and red-longs, and between white-longs and red-shorts and in both cases the long-red female offspring were paired to short-white males. In this way the F_2 progeny gave directly a measure of the classes of gametes produced by the long-red F_1 females, except as they may have been affected by differences of viability. When white-shorts were mated with red-longs, the female offspring were of composition, *wmx—x*, giving excess of white-shorts and red-longs over the other two possible combinations; and when white-longs were mated with red-shorts, the female offspring were of composition, *wx—mx*, giving excess of white-longs and red-shorts.

Daughters of white-shorts by red-longs gave 3,371 red-longs, 1,136 red-shorts, 1,571 white-longs and 2,064 white-shorts.

Positive association of *w* and *m* is given by the equation

$$\frac{\text{red-longs} + \text{white-shorts}}{\text{red-shorts} + \text{white-longs}} = \frac{5{,}435}{2{,}707} = 2.$$

Greater viability of the longs is shown by the equation

$$\frac{\text{longs}}{\text{shorts}} = \frac{4{,}942}{3{,}200} = 1.54.$$

Greater viability of the reds is shown by the equation

$$\frac{\text{reds}}{\text{whites}} = \frac{4{,}507}{3{,}635} = 1.24.$$

Daughters of white-longs by red-shorts gave 1,047 red-longs, 1,116 red-shorts, 1,651 white-longs, 671 white-shorts.

Negative association of *w* and *m* is given by the equation

$$\frac{\text{red-longs} + \text{white-shorts}}{\text{red-shorts} + \text{white-longs}} = \frac{1{,}718}{2{,}767} = 0.62.$$

According to previous work on these factors this equation should have given 0.50, and we may suppose that larger numbers would have corrected this discrepancy.

Greater viability of the longs is shown by the equation

$$\frac{\text{longs}}{\text{shorts}} = \frac{2{,}698}{1{,}787} = 1.51.$$

In this case the whites appear in excess of the reds.

$$\frac{\text{reds}}{\text{whites}} = \frac{2,163}{2,322} = 0.931.$$

Dividing the sum of all the reds bred by the sum of all the whites bred we get an excess of reds—6,670 : 5,957 = 1.12.

These counts add nothing new to the theory of association, but are in agreement with Morgan's ratios.

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A DISCUSSION OF THE RESULTS OBTAINED BY CROSSING ZEA MAIS L. (MAIS DJAGOENG) (—REANA LUXURIANS DUR.—TEOSINTE) AND EUCHLÆNA MEXICANA SCHRAD[1]

THE author prefaces his discussion of the hybrids of maize and teosinte with a minute study of the male and female spikelets of both plants, showing the similarity between them.

After reviewing the work of Harshberger with the cross maize ♂ × teosinte ♀, he takes up the result of his own reciprocal cross, maize ♀ × teosinte ♂. He shows that the first generation hybrids by the latter cross were uniform and agree closely with those from the reciprocal cross made by Harshberger.

The plants of the second hybrid generation of the cross, maize ♀ × teosinte ♂ form a diverse series, of which the different individuals differ widely in stooling and branching ability, as well as in the structure of the ear. A complete reversion, however, to either one of the parent types never occurs. The series tends more towards the maize than the teosinte type, and it is shown that associated with the stronger development of the maize type, is a reduction in the number of branches, a reduction in the number of ears per plant, a less horny texture of the axis and of the calyx-glumes, and a reduction in the depth of the pits of the axis. The nature of the diversity in the second hybrid generation argues against the absolute purity of the sex cells.

[1] "A Discussion of the Results Obtained by Crossing *Zea mais* L. (*Mais Djagoeng*) (*-Reana luxurians* Dur. *-teosinte*) and *Euchlœna mexicana* Schrad," by J. E. van der Stok, in *Teysmannia*, Vol. 21, 1910, p. 47–59. The translation upon which this abstract is based was made by Karle Lotsy, Bureau of Plant Industry, U. S. Dept. of Agriculture, Washington, D. C.